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HYDRAULIC CONTROLLER OF CONSTRUCTION MACHINE

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HYDRAULIC CONTROLLER OF CONSTRUCTION MACHINE

[Kensetsu kikai no yuatsu seigyo sochi]

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Claims

1. A type of hydraulic controller of a construction machine, characterized by the following facts: in the hydraulic controller, by manipulating an electric joystick, an electrical signal corresponding to the manipulation quantity is output to a controller; corresponding to the electrical signal from the controller, an instruction signal is sent through an electromagnetic proportional pressure-reducing valve to the pilot pressure receiving portion of a pilot switching valve; due to operation of the pilot switching valve, a hydraulic actuator is controlled; in this hydraulic controller, an output booster is arranged on the controller; when the electrical signal is input from the electric joystick to the controller, based on said electrical signal, the electrical

signal output value is increased by said output booster, and, under control of the controller, the increased electrical signal output acts on the electromagnetic proportional pressure-reducing valve only for a prescribed time.

2. The hydraulic controller of a construction machine described in Claim 1, characterized by the fact that when the output signal output from the electric joystick is shifted from a certain state to another state, an instruction signal is output corresponding to the shift quantity from the controller to the electromagnetic proportional pressure-reducing valve.

Detailed explanation of the invention

Industrial application field

This invention pertains to a type of hydraulic controller for control of various types of hydraulic actuators equipped in hydraulic shovels and other construction machines.

Prior art

Figure 5 is a circuit diagram illustrating the main portion of the hydraulic controller in the prior art. As shown in this figure, (1) represents an electric joystick; (2) represents a controller; (3) and (4) represent electromagnetic proportional pressure-reducing valves; (5) and (6) represent solenoids of said electromagnetic proportional pressure-reducing valves (3) and (4), respectively; (7) represents a pilot pressure hydraulic source; (8) represents a hydraulic actuator; (9) represents a pilot switching valve for controlling hydraulic actuator (8); (10) and (11) represent the pilot pressure receiving portions of pilot switching valves (9); (13) and (14) represent their throttle portions; (15) represents a main pump; and (16) represents a hydraulic fluid tank.

In the following, the hydraulic controller of the prior art will be explained with reference to Figure 5. By turning manipulating lever (17) of electric joystick (1) from the neutral position towards position A or position B, an electrical signal corresponding to the manipulating quantity is output to controller (2). On the basis of said electrical signal, controller (2) makes a judgment, and outputs an electrical signal to solenoid (5) or (6). As solenoid (5) or (6) is ON, electromagnetic proportional pressure-reducing valve (3) or (4) works. The pilot pressure from pilot pressure source (7) goes through electromagnetic proportional pressure-reducing valve (3) or (4) and acts on pilot pressure receiving unit (11) or (12). Pilot switching valve (9) is manipulated to switch towards position C or position D. The main pump pressurized hydraulic fluid from main pump (15) goes through position C or position D of pilot switching valve (9), and is fed to the hydraulic actuator.

Figure 6 is a diagram illustrating the relationship between the output value of the electrical signal output from electric joystick (1) and the output value of the electrical signal output from controller (2). As shown in Figure 6, an electrical signal proportional to the output

value of the electrical signal output from electric joystick (1) to controller (2) is output from controller (2) to electromagnetic proportional pressure-reducing valve (3) or (4). For example, if the electrical signal output from electric joystick (1) is A_1, the output of the electrical signal output from controller (2) is B_1.

Figure 7 is a diagram illustrating the relationship between the time when electric joystick (1) is manipulated and the output from electric joystick (1) and controller (2). For example, as shown in Figure 6, when an electrical signal is input to controller (2) in step form up to output value A_1, the output from controller (2) becomes the step waveform shown in Figure 7 corresponding to the proportional amplification ratio of controller (2).

Problems to be solved by the invention

In the pilot pressure circuit, by manipulating the electric joystick, the electromagnetic proportional pressure-reducing valve is manipulated through the controller, and the pilot pressure guided out from the electromagnetic proportional pressure-reducing valve acts on the pilot switching valve for controlling the hydraulic actuator. In this pilot pressure circuit, in order to ensure a high safety for the spool within the pilot switching valve, throttle portions (throttle portions (13) and (14) in Figure 5) are arranged near the port of the pilot pressure receiving portion of the pilot switching valve. Consequently, the pipeline resistance of said pilot pressure circuit increases, and the responding property of the pilot switching valve degrades when the electric joystick is manipulated. Especially, in wintertime, the viscosity of the manipulating hydraulic fluid becomes higher, and problems occur in the hydraulic shovels and other construction machines.

The purpose of this invention is to solve the aforementioned problems of the prior art by providing a type of hydraulic controller characterized by the fact that when throttle portions are arranged with respect to the pilot pressure receiving portion of the pilot switching valve, or when there is no said throttle portion yet the pipeline resistance is high for the pilot pipeline going from the pilot valve to the pilot pressure receiving portion, the response is quick with respect to the pilot pressure receiving portion of the pilot switching valve.

Means to solve the problems

In order to solve the aforementioned problems, this invention provides:

(2)A. The hydraulic controller of a construction machine described in Claim 1, characterized by the following facts:

(1)A. an output booster is arranged on the controller;

(1)B. when the electrical signal is input from the electric joystick to the controller, based on said electrical signal, the electrical signal output value is increased by said output booster, and

under control of the controller, the increased electrical signal output acts on the electromagnetic proportional pressure-reducing valve only for a prescribed time.

(2)B. When the output signal output from the electric joystick is shifted from a certain state to another state, an instruction signal is output corresponding to the shift quantity from the controller to the electromagnetic proportional pressure-reducing valve.

Operation

(1)A. When the electric joystick is manipulated, the electrical signal output from the electric joystick is input to the controller, and the output is increased by the output booster.

(1)B. Because the electrical signal that is increased for the output as described in said section A acts on the electromagnetic proportional pressure-reducing valve under control of the controller for a prescribed instant time t, the hydraulic output from the electromagnetic proportional pressure-reducing valve is proportional to the output from said controller as it acts on the pilot pressure receiving portion of the pilot switching valve. The spool of the pilot switching valve works quickly only for instant time t, and after that, a stroke is performed until balance is reached in the hydrostatic pressure matched to the prescribed output.

(2)A. When the electrical signal output from the controller is to be shifted only slightly, or when the manipulating lever of the electric joystick is shaken due to rocking of the hands of the operator, for the controller described in Claim 1, poor inching property of manipulation, hunting shock, etc., may take place. In order to prevent such problems, when the output signal output from the electric joystick is shifted from a certain state to another state, an instruction signal corresponding to the shift quantity is output from the controller to the electromagnetic proportional pressure-reducing valve.

Application examples

In the following, this invention will be explained in more detail with reference to application examples. Figure 1 is a circuit diagram illustrating the main portion of the hydraulic controller in this invention. In the figure, the same part numbers as those used in the prior art are adopted to represent the same structural elements. (18) represents a controller; (19) represents an output booster arranged on controller (18), and (20) represents a shift state detector for the electrical signal.

In the following, the constitution of the hydraulic controller in this invention will be explained with reference to Figure 1. Output booster (19) is arranged on controller (18). When the electrical signal is input from electric joystick (1) to controller (18), in controller (18), the electrical signal output value is increased by output booster (19) corresponding to said electrical signal. The increased electrical signal acts on electromagnetic proportional pressure-reducing

valve (3) or (4) only for a prescribed time by means of controller (18). Also, shift state detector (20) for the electrical signal is arranged on controller (18), and when the output signal output from electric joystick (1) is shifted from a certain state to another state, an instruction signal corresponding to the shift quantity is output from controller (18) to electromagnetic proportional pressure-reducing valve (3) or (4).

In the following, the operation and function of the hydraulic controller of this invention will be explained. When manipulating lever (17) of electric joystick (1) is manipulated, the electrical signal output from said electric joystick (1) is input to controller (18), and the output is increased by output booster (19). The output increased electrical signal acts on electromagnetic proportional pressure-reducing valve (3) or (4) only in a prescribed instant time t under control of controller (18). Consequently, the hydraulic output from electromagnetic proportional pressure-reducing valve (3) or (4) is proportional to the output from said controller (18), and it acts on pilot pressure receiving portion (11) or (12) of pilot switching valve (9). Figure 2 is a diagram illustrating the relationship between the time of manipulation of electric joystick (1) in the hydraulic controller of this invention and output A from electric joystick (1) as well as output B from controller (18). As shown in Figure 2, for output B from controller (18), the output increases only for instant time t. Figure 3 is a diagram illustrating the relationship between time T when electric joystick (1) is manipulated in this invention and stroke S of the spool (not shown in the figure) in pilot switching valve (9). In Figure 3, dot-dash curve l represents the case of the hydraulic controller in the prior art, and solid curve f represents the case of the hydraulic controller in this invention. Broken line f'_1 branched from the solid curve f represents the case of lasting extension of rise in the output of prescribed instant time t. (The state of said broken line f'_1 shows the portion of broken line f'_2 in Figure 2). As shown in Figure 3, in the prior art, the time for movement of the spool to stroke S_1 is T_1, while the time becomes shorter (T_2) in this invention.

Figure 4 is a diagram illustrating the state when the output of the electrical signal from controller (18) is shifted from B_2 to B'_2, as output of the electrical signal from electric joystick (1) is shifted from A_2 to A'_2. As shown in Figure 4, when the electrical signal output from controller (18) is shifted slightly, or when manipulating lever (17) of electric joystick (1) moves due to shaking of the hands of the operator, for controller (18) equipped with output booster (19), poor inching property of manipulation, hunting shock, etc., may take place. In order to prevent said problems, when the output signal is output from electric joystick (1) from a certain state to another state, the instruction signal corresponding to the shift quantity is output to electromagnetic proportional pressure-reducing valve (3) or (4) from controller (18). As a result, it is possible to prevent said inching trouble, hunting shock, or other problems in said aforementioned manipulation.

Effect of the invention

By manipulating the electric joystick, the electromagnetic proportional pressure-reducing valve is operated through a controller. The pilot pressure fed out from the electromagnetic proportional pressure-reducing valve acts on the pilot switching valve for controlling the hydraulic actuator. In this pilot pressure circuit, in order to ensure the stability of the spool inside the pilot switching valve, throttle portions are arranged near the port of the pilot pressure receiving portion of the pilot switching valve. Consequently, the pipeline resistance of said pilot pressure circuit increases, and when the electric joystick is manipulated, the responding property of the pilot switching valve degrades. Especially, in wintertime, viscosity of the manipulating hydraulic fluid becomes higher, and operation of the hydraulic shovels and other construction machines is hampered.

However, in the hydraulic controller of this invention, when the electrical signal is input from the electric joystick to the controller, the electrical signal output value is increased by the output booster. The increased electrical signal is applied only for a prescribed time on the electromagnetic proportional pressure-reducing valve under control of the controller. As a result, when throttle portions are arranged with respect to the pilot pressure receiving portion of the pilot switching valve, or although there is no said throttle portion yet the resistance of the pipeline of the pilot pipeline from the pilot valve to the pilot pressure receiving portion increases, response to the pilot pressure receiving portion of the pilot switching valve can be quick.

Also, when the output signal output from the electric joystick is shifted from a certain state to another state, an instruction signal corresponding to the shift quantity is output from the controller to the electromagnetic proportional pressure-reducing valve. As a result, it is possible to prevent the problem of inching property in manipulation of the electric joystick, the hunting shock, and other problems.

Brief description of the figures

Figure 1 is a circuit diagram illustrating the main portion of the hydraulic controller in this invention. Figure 2 is a diagram illustrating the relationship between the time and output when the electric joystick is manipulated in this invention. Figure 3 is a diagram illustrating the relationship between the time and the spool stroke when the electric joystick is manipulated in this invention. Figure 4 is a diagram illustrating the state of shifting of the outputs from the electric joystick and the controller. Figure 5 is a circuit diagram illustrating the main portion of the hydraulic controller in the prior art. Figure 6 is a diagram illustrating the output from the electric joystick and the controller. Figure 7 is a diagram illustrating the relationship between the time and output when the electric joystick is manipulated in the prior art.

1 Electric joystick
2, 18 Controller
3, 4 Electromagnetic proportional pressure-reducing valve
7 Pilot pressure hydraulic source
8 Hydraulic actuator
9 Pilot switching valve
11, 12 Pilot pressure receiving portion
13, 14 Throttle portion
19 Output booster
20 Shift state detector

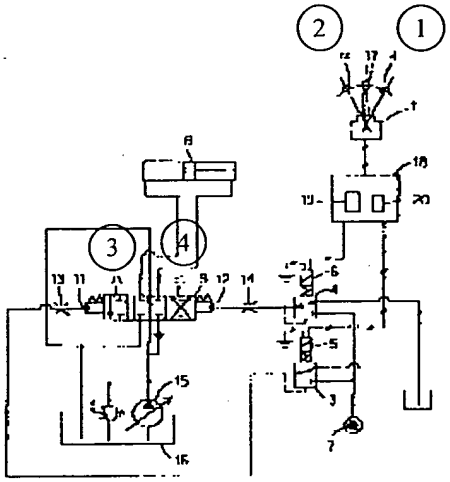

Figure 1

Key: 1 A
2 B
3 C
4 D

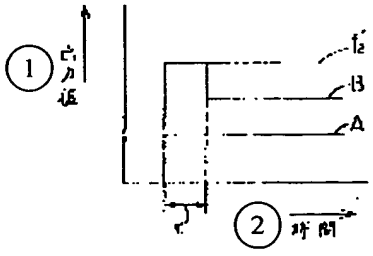

Figure 2

Key: 1 Output value
2 Time

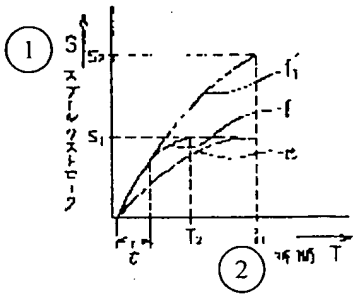

Figure 3

Key: 1 Stroke of spool
2 Time

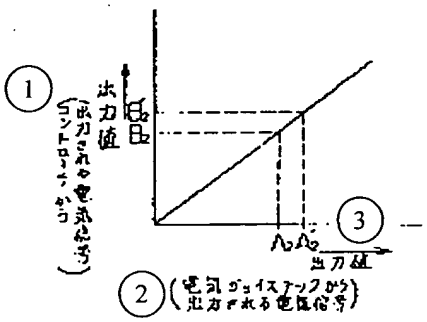

Figure 4

Key: 1 Output value (electrical signal output from controller)
2 Electrical signal output from electric joystick
3 Output value

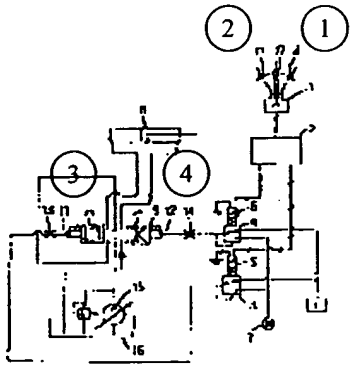

Figure 5

Key: 1 A
2 B
3 C
4 D

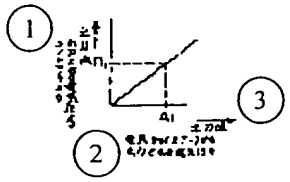

Figure 6

Key: 1 Output value (electrical signal output from controller)
2 Electrical signal output from electric joystick
3 Output value

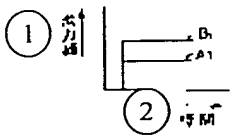

Figure 7

Key: 1 Output value
2 Time